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## XXII. *Description of an acid principle prepared from the lithic or uric acid.* *By* William Prout, *M. D.* *Communicated by* W. H. Wollaston, *M. D. F. R. S.*

Read June 11, 1818.

During an investigation of the principles of the urine, with the view of elucidating the pathology of that secretion, I was led to examine the well-known beautiful purple substance produced by the action of the nitric acid and heat upon the lithic acid, and which has usually been considered as one of the characteristic distinctions of the lithic acid. This purple substance proved to be a compound of ammonia, and a peculiar principle having the properties of an acid; the description of which, and of its compounds, constitutes the object of the present paper.

This acid principle may be obtained by digesting pure lithic acid in dilute nitric acid: an effervescence takes place, and the lithic acid is dissolved. The excess of nitric acid is then to be neutralized with ammonia, and the whole slowly concentrated by evaporation. As the evaporation proceeds, the colour of the solution gradually becomes of a deeper purple, and dark red granular crystals (sometimes of a greenish hue externally) soon begin to separate in abundance. These crystals are a compound of ammonia with the acid principle in question. The ammonia may be removed by the sulphuric or muriatic acid, and thus the acid principle obtained in a separate state. As, however, I found some

little care requisite to obtain the acid quite free from colour, it may not be deemed superfluous to state the precise method I usually followed for that purpose. The compound with ammonia, above-mentioned, was dissolved in a solution of caustic potash, and heat applied to the solution till the red colour entirely disappeared. This alkaline solution was then gradually dropped into dilute sulphuric acid, which uniting with the potash, left the acid principle in a state of purity.

The acid principle is likewise produced from lithic acid by chlorine. Iodine has also the same remarkable property, though in a much less striking degree. When lithic acid is boiled with iodine for some time, a partial solution of the lithic acid is effected; and if to this solution a little ammonia be added, and the whole evaporated to dryness, a perceptible quantity of the beautiful purple compound of ammonia and the new acid principle will be obtained. I am not aware that any other substance is capable of producing this change, though the circumstance is by no means improbable.

To prevent circumlocution, I shall in future call this principle the *purpuric acid*, a name suggested by Dr. WOLLASTON, from its remarkable property of forming compounds with most bases of a red or purple colour.

The purpuric acid, as obtained above, usually exists in the form of a very fine powder, of a slightly yellowish or cream colour; and when examined with a magnifier, especially in water, appears to possess a pearly lustre. It has no smell nor taste. Its specific gravity is considerably above that of water, though from the minute state of division in which it exists, it usually takes a considerable time to subside in that fluid. When suffered to separate slowly from a large quantity

of water, or any other fluid capable of holding it in solution, it sometimes assumes the form of thin pearly scales.

The purpuric acid is very little soluble in water. One tenth of a grain boiled for a considerable time in 1000 grains of water was not entirely dissolved. The water assumed a purple tint, which it retained after it was cold, though it became very slightly turbid on cooling.* The purpuric acid is insoluble in alcohol and ether. In all the mineral acids, when concentrated, and in excess, and in solutions of the different alkalies, it dissolves readily; but it is insoluble, or nearly so, in dilute sulphuric, muriatic, and phosphoric acids, and also in solutions of the oxalic, citric, and tartaric acids. Concentrated nitric acid readily dissolves it with effervescence; and if the acid be in excess, and heat be applied, a portion of the purpuric acid is decomposed, ammonia is formed, and on driving off the excess of nitric acid by heat, the purpurate of ammonia is obtained, precisely as if a little of the lithic acid had been treated in a similar manner. Chlorine, likewise, dissolves the purpuric acid, and apparently produces the same changes upon it as the nitric acid. It readily dissolves also by the assistance of heat, in concentrated acetic acid.

The purpuric acid does not sensibly affect litmus paper, probably on account of its insoluble nature. When exposed to the air it does not deliquesce, but gradually assumes a purplish tint, apparently by attracting a little ammonia from

* I am not quite sure whether the purple tint here mentioned depends upon the actual solution of a minute portion of the purpuric acid; and, consequently, whether it naturally forms a purple solution, or whether the colour be owing to the formation of a little ammonia from the decomposition of a minute proportion of the acid, which, combining with the remainder of the acid, forms the purpurate of ammonia. I incline to the latter opinion.

the atmosphere, or perhaps from the evolution from itself of a little of the same alkali by spontaneous decomposition.

Submitted to heat, it neither melts nor sublimes, but acquires a purple hue from the formation of ammonia, and afterwards burns gradually, without yielding any remarkable odour. Subjected alone to heat in close vessels, it yields a considerable proportion of the carbonate of ammonia, some prussic acid, and a little fluid having an oily appearance; while a portion of pulverulent charcoal remains. When given quantities were burnt with the oxide of copper, in the manner formerly described by me,* data were obtained, which appeared to show that one hundred parts consist of

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|---|---|---|
| Hydrogen | 4.54 | corresponding with 2 atoms or proportions. |
| Carbon | 27.27 | 2 ditto. |
| Oxygen | 36.36 | 2 ditto. |
| Azote | 31.81 | 1 ditto. |

The purpuric acid combines with the alkalies, alkaline earths, and metallic oxides. It is capable of expelling the carbonic acid from the alkaline carbonates, by the assistance of heat, and does not, as far as I have observed, combine with any other acid. These are circumstances sufficient, as Dr. WOLLASTON has observed, to distinguish it from an *oxide*, and to establish its character as an *acid*. On the supposition then, that it be named the *purpuric acid*, its compounds with different bases must be denominated *purpurates*: on some of the most remarkable of which I shall now proceed to make a few remarks.

*Purpurate of ammonia.* This salt crystallizes in quadrangular prisms, which, when viewed by transmitted light, are

* See Medico-Chirurgical Transactions, vol. viii. p. 526.

transparent, and of a deep garnet red colour; but by reflected light, their two broadest opposite faces appear of a brilliant green, closely resembling that of the wings of some of the beetle tribe, as for example, of the *Cetonia aurata*, while their other two opposite faces appear of a dull reddish brown colour; or if the light be very strong, slightly green. This peculiarity seems to be possessed in a greater or less degree by all the other alkaline, and perhaps earthy salts; and doubtless depends upon the structure of the crystals. The purpurate of ammonia is soluble in about 1500 parts of water at 60°, but in boiling water is much more soluble. The solution is of a beautiful deep carmine, or rose red colour. In pure alcohol and in ether, it is little if at all soluble. The aqueous solution has a slightly sweetish taste, but no smell. By adding this aqueous solution of the purpurate of ammonia to neutral saline solutions of other bases, most of the following purpurates were formed.

*Purpurate of potash.* When a saturated boiling solution of the purpurate of ammonia is added to a solution of the bicarbonate of potash, a dark brownish red precipitate takes place, which is the purpurate of potash. If, however, this salt be slowly formed, it may be obtained in a crystalline form; and the crystals appear to possess the same peculiarity with respect to colour, as those of the purpurate of ammonia above-mentioned. This salt is much more soluble than the purpurate of ammonia.

*Purpurate of soda.* This salt, when obtained by the same means as the purpurate of potash, is of a dark brick red colour. It may, however, be obtained in crystals. It is much less soluble than the purpurate of potash. Three thousand times its weight of water at 60°, did not completely dissolve

it. The colours of the solutions of this salt, and of potash, differ slightly from one another, and also from that of the purpurate of ammonia; but it is not easy to describe these differences so as to render them intelligible.

*Purpurate of lime.* This salt, when obtained by adding a boiling saturated solution of the purpurate of ammonia to a solution of the muriate of lime, exists in the form of a powder much resembling in colour the crust of the lobster before it is boiled. This salt is but little soluble in cold water; but in boiling water it is more soluble, and the solution is of a beautiful reddish purple colour.

*Purpurate of strontian.* This salt obtained as above, with the nitrate of strontian, exists in the state of a dark brownish red powder, with a slight tinge of green. It seems to be more soluble than the purpurate of lime, and forms a purple solution.

*Purpurate of barytes.* Obtained as before described, with the acetate of barytes, this salt assumes the form of a dark green powder, not apparently differing much in point of solubility from the purpurate of strontian; and forming, like that salt, a purple solution.

*Purpurate of magnesia.* This is a very soluble salt. Its solution is of a beautiful purple.

*Purpurate of alumina.* When a solution of the purpurate of ammonia was added to a solution of alum, no perceptible change took place immediately; but after some time the colour of the solution disappeared, and a small quantity of a white substance separated, which was presumed to be the purpurate of alumina, but it was not examined.

*Purpurate of gold.* When a solution of the muriate of gold is dropped into a solution of the purpurate of ammonia, the

colour becomes yellowish, but no precipitation takes place. Hence, this salt may be presumed to be very soluble.

*Purpurate of platina.* The muriate of platina changes the colour of the purpurate of ammonia to a yellowish scarlet, but produces no precipitation.

*Purpurate of silver.* Solutions of the acetate or nitrate of silver, dropped into a solution of the purpurate of ammonia, produce a deep purple precipitate; and the water is left nearly colourless. Hence the purpurate of silver appears very insoluble.

*Purpurate of mercury.* A solution of the proto-nitrate of mercury produces, with the purpurate of ammonia, a beautiful reddish purple precipitate, and the water is left nearly colourless. A solution of the oxymuriate of mercury produces at first no change; but after some time a copious light rose coloured precipitate occurs, and the solution is left colourless.

*Purpurate of lead.* A solution of the nitrate of lead, dropped in a solution of the purpurate of ammonia, renders it of a rose red colour; but no precipitation takes place.

*Purpurate of zinc.* A solution of the acetate of zinc produces with the purpurate of ammonia, a solution and precipitate of a beautiful gold yellow colour; and a most brilliant iridescent pellicle, in which green and yellow predominate, forms on the surface of the solution.

*Purpurate of tin.* A solution of the muriate of tin changes the purpurate of ammonia to a scarlet; but this rapidly disappears, and the solution becomes colourless. After a few hours, white pearly crystals form in abundance, which is the purpurate of tin.

*Purpurate of copper.* A solution of the acetate or sulphate of copper changes the purpurate of ammonia to a bright yellowish green colour, but produces no precipitation.

*Purpurate of nickel.* The nitrate of nickel imparts to the purpurate of ammonia a greenish tinge, but produces no precipitation.

*Purpurate of cobalt.* The acetate of cobalt changes the colour of the same salt to a pale scarlet. After some time, reddish granular crystals form, which are the purpurate of cobalt.

*Purpurate of iron.* A solution of the green sulphate of iron changes the colour of the purpurate of ammonia to yellowish red, but produces no precipitate.

Such is a very brief account of the *purpurates*, as far as I have examined them. It may at first sight appear singular, that such an insoluble acid should form so many soluble compounds; but when we reflect upon the subject, and consider what a very small quantity of the purpurate of ammonia is retained in solution by water, and that this small quantity has been made the standard of comparison in the above experiments, our surprize is considerably lessened, and we feel no difficulty in conceiving, that if the purpurates were compared with the nitrates, for example, the former would be found by far the least soluble.

From the very small quantities on which I have been obliged to operate, and from other circumstances, I can offer but little respecting the constitution of the purpurates. Those which I have attempted to analyze appear to be anhydrous, and to be composed of two atoms of the acid, and one of the base; and if this be correct, the

same composition may perhaps be referred to most, if not all the compounds above mentioned. The purpuric acid, however, appears capable of forming subsalts and supersalts, with most bases, many of which seem to be very little soluble.

With respect to the characteristic properties of the purpuric acid, I apprehend it may be readily distinguished from all other substances by the beautiful colours exhibited by its alkaline and earthy salts, independently of its other properties, which are likewise peculiar.

The purpuric acid, and its compounds, probably constitute the basis of many animal and vegetable colours. The well known pink sediment, which generally appears in the urine of those labouring under febrile affections, appears to owe its colour chiefly to the purpurate of ammonia, and perhaps occasionally to the purpurate of soda. Some of the purpurates, as for example that of lime, might be probably used as a paint. They might be also used for dying, especially wool and other animal productions.* On this part of the subject, however, as I have little that is certain to offer, I do not deem it prudent to enter at present.

* I may here observe, that the solution of lithic acid in nitric acid, has the property of tinging the skin and other animal substances in a very permanent manner. The colour does not, in general, appear till the substance has been exposed to heat, or what is more effective, to the light of the sun. In the latter case, particularly, a deep purple tint soon makes its appearance, and the substance tinged (more especially the skin) emits during the process a strong and peculiar smell, closely resembling that produced by the nitrate of silver, when applied to the skin, and exposed to similar circumstances.